

what is claimed is:

1. A combined, fixed codebook searching method used in a code excited linear prediction (CELP) speech codec, the method comprising:

searching for a fixed codebook using a full search method that searches for the fixed codebook at all pulse positions;

selecting a fixed codebook searching method by counting the number of users who are accessing a gateway, comparing the number of users with a predetermined threshold, and selecting a proper fixed codebook searching method based on the result of comparison;

searching for the fixed codebook using the selected fixed codebook searching method; and

checking whether the search for the fixed codebook is complete for all tracks of the CELP speech codec, terminating a routine of searching for the fixed codebook when it is determined the search is complete for all the tracks, and selecting a fixed codebook searching method again in consideration of the number of gateway users when there remains a track to be searched for.

2. The method of claim 1, wherein during selecting a fixed codebook searching method, the full search method is selected when the number of gateway users is smaller than a predetermined first threshold, a focused search method is selected when the number of gateway users is the same as or larger than the predetermined first threshold and is smaller than or the same as a predetermined second threshold, and a depth-first tree search method is selected when the number of gateway users is the same as or larger than the predetermined second threshold.

3. The method of claim 1, wherein during searching for a fixed codebook using a selected fixed codebook searching method, when the focused search method is selected, a threshold is predetermined using the correlation between all pulse positions of an upper-rank track, a sum of combinations of all the pulse positions of the upper-rank track is compared with the threshold, and pulse positions of a last track are searched for only when the sum is larger than the threshold.

4. The method of claim 3, wherein the threshold is computed by subtracting an average correlation value C_{av} at all pulse positions of the upper-rank

track from a maximum correlation value C_{max} , multiplying the result of subtraction by a predetermined coefficient, and combining the result of multiplication and the average correlation value C_{av} .

5 5. The method of claim 4, wherein the predetermined coefficient is a constant that adjusts the number of combinations of pulse positions and has a value ranging between 0 and 1, and

 the maximum correlation value C_{max} and the average correlation value C_{av} are expressed using the following equations, respectively;

$$C_{max} = \sum_{m=0}^{T-2} \text{Maxsign} \{b(Tn+m)\} d(Tn+m),$$

$$C_{av} = \frac{1}{M} \left\{ \sum_{m=0}^{T-2} \sum_{n=0}^{M-1} \text{sign} \{b(Tn+m)\} d(Tn+m) \right\},$$

 wherein T denotes the number of tracks in a sub frame, M denotes the number of pulse positions per track, and b denotes a pulse-position likelihood-estimate vector.

15 6. The method of claim 4, wherein the predetermined coefficient is increased when the number of gateway users who are accessing the gateway increases, and is reduced when the number of gateway users decreases.

20 7. The method of claim 1, during searching for a fixed codebook using a selected fixed codebook searching method, when the focused search method is selected, the fixed codebook is searched using the focused search method, and the coefficient K , which adjusts the number of combinations of pulse positions, is adjusted in consideration of the number of gateway users.

25 8. The method of claim 1, wherein during searching for a fixed codebook using a selected fixed codebook searching method, when the depth-first tree search method is selected, pulse positions are sequentially, continuously searched for every two tracks,

30 wherein several candidate pulse positions are selected in one of two tracks using an absolute value of the pulse-position likelihood-estimate vector and pulse positions of the other track are searched for.

9. The method of claim 8, wherein the pulse-position likelihood-estimate vector is expressed using the following equation:

$$b(n) = \frac{\begin{matrix} r_{LTP}(n), \\ dn, \end{matrix}}{\sqrt{\sum_{i=0}^{N-1} r_{LTP}(i)r_{LTP}(i)} + \sqrt{\sum_{i=0}^{N-1} d(i)d(i)}}$$

5 wherein $r_{LTP}(n)$ denotes a pitch residual signal and N denotes the length of a sub frame.

10. The method of claim 1, wherein during searching for a fixed codebook using a selected fixed codebook searching method, when the depth-first tree search method is selected, the fixed codebook is searched for using the depth-first tree search method, and the number of candidate pulse positions is reduced when the number of gateway users who are accessing the gateway increases.

11. A computer-readable recording medium on which a program to execute the method of claim 1 using a computer is recorded.

12. A combined, fixed codebook searching apparatus used in a CELP speech codec, the apparatus comprising:

a full-search processor that searches for a fixed codebook using the full search method that searches for the fixed codebook at all pulse positions;

a search method selector that counts the number of gateway users who are accessing a gateway, compares the number of gateway users with a predetermined set value, and selects a fixed codebook search method based on the result of comparison; and

a fixed codebook search processor that searches for the fixed codebook using the selected fixed codebook search method selected.

13. The apparatus of claim 12, wherein the search method selector selects the full search method when the number of gateway users is smaller than a predetermined first set value, selects the focused search method when the number of gateway users is the same as or larger than the predetermined first set value and is smaller than or the same as a predetermined second set value, and selects the depth-first tree search method when the number of gateway users is the same as or larger than the predetermined second set value.

14. The apparatus of claim 12, wherein the fixed codebook searching processor searches for the fixed codebook using one of the full search method, the focused search method, and the depth-first tree search method, based on an output of the search method selector.